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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/611,931	07/03/2003	Panayotis C. Andricacos	YOR920020368US1	3968
30678	7590	04/06/2005	EXAMINER	
CONNOLLY BOVE LODGE & HUTZ LLP			CHU, CHRIS C	
SUITE 800			ART UNIT	
1990 M STREET NW			PAPER NUMBER	
WASHINGTON, DC 20036-3425			2815	

DATE MAILED: 04/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/611,931

Applicant(s)

ANDRICACOS ET AL.

Examiner

Chris C. Chu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 19 January 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1, 4 - 8, 14 - 18 and 20 - 48 is/are pending in the application.
- 4a) Of the above claim(s) 27 - 37 and 40 - 42 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20 - 24, 39, 47 and 48 is/are allowed.
- 6) ☒ Claim(s) 1, 4 - 8, 14, 15, 38 and 43 - 46 is/are rejected.
- 7) ☒ Claim(s) 16 - 18, 25 and 26 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment filed on January 19, 2005 has been received and entered in the case.

### ***Information Disclosure Statement***

2. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Since applicant has not responded or amended the statement in the above paragraph, the statement is maintained.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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4. Claims 1, 4 – 6, 14, 15 and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Chung '607.

Regarding claims 1 and 38, Chung discloses in e.g., Figs.3 – 6 and column 7, lines 15 – 55 a method for fabricating a patterned copper structure which comprises

- providing a dielectric material (4) on a substrate (2; column 3, lines 4 – 5),
- providing at least one trench/via (at the trench that is pointed by the element 6) in the dielectric material;
- providing a liner (6) on the bottom and sidewalls of the at least one trench/via and on horizontal surfaces of the dielectric material in the vicinity of the at least one trench/via;
- depositing copper (Cu 8; column 7, lines 23 – 29) in the at least one trench/via on the liner; and
- selectively etching the copper (12 in Fig. 4 and column 7, lines 37 - 49) by electroetching to recess the copper with respect to the top surfaces of the dielectric; and then
- selectively depositing on the Cu, one or more materials (14) by electrolytic plating or by electroless plating (the electroplating process or electroless plating of the barrier layer 14 on column 7, lines 15 – 22 and lines 49 – 54).

Furthermore, according to applicants' specification on page 7, section 0040, the electropolishing is a part of an electroetching and Chung discloses in e.g., column 7, lines 45 – 47 an electropolishing to etch the Cu layer. Chung discloses electroetching.

Regarding claim 4, Chung discloses in e.g., Fig. 5 and column 7, lines 15 – 55 the selective Cu etching being followed by blanket deposition (the deposition of the element

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14 in Fig. 5) of one or more barrier or dielectric materials (Figs. 5 – 7 and column 7, lines 57 – 67).

Regarding claim 5, Chung discloses in e.g., Fig. 5, Fig. 6 and column 7, lines 15 – 55 said blanket deposition being followed by planarization for removing liner (6) from the horizontal surfaces of the dielectric (4 and see Fig. 6).

Regarding claim 6, Chung discloses in e.g., Fig. 6 and column 7, lines 15 – 55 the selective Cu etching being followed by the selective deposition (14) on the Cu of one or more materials by electrolytic plating (the electroplating process of the barrier layer 14 on column 7, lines 15 – 22 and lines 49 – 54).

Regarding claim 14, since Chung discloses in e.g., column 8, lines 7 – 19 the substrate having series of layers on top of the substrate, Chung discloses said selective deposition by electrolytic plating (14) being followed by the blanket deposition of a metal or alloy (the metal layer or barrier layer that forms in any of the upper layer).

Regarding claim 15, since Chung discloses in e.g., column 8, lines 7 – 19 the substrate having series of layers on top of the substrate, Chung discloses planarization following said blanket deposition.

### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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6. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung in view of Liu et al. '274.

Regarding claim 7, while Chung teaches the use of the material layer on the Cu, Chung does not appear to provide the material layer's specific composition. Liu et al. teaches in column 3, lines 48 – 52 using Co as a specific composition for a material layer (22) with TaN layer on a Cu (18). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to add the Co as the specific composition for the material layer with TaN layer on the Cu of Chung as taught by Liu et al. to avoid copper corrosion and oxidation of planarized final copper structure (column 3, line 67 – column 4, line 3).

Regarding claim 8, Chung discloses in e.g., Fig. 5, Fig. 6 and column 7, lines 15 – 55 said electrolytic plating being followed by planarization for removing liner (6) from the horizontal surfaces of the dielectric (4).

7. Claims 43 – 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung in view of Dubin et al. (U. S. Pat. No. 6,696,758).

While Chung teaches the use of the material layer on the Cu, Chung does not appear to provide the material layer's specific composition (i.e., Co in claims 43 and 45, and Ru in claims 44 and 46) and the material layer being two layers (claims 43 and 45). Dubin et al. teaches in e.g., Fig. 1 and column 5, lines 12 – 53 using Co and Ru as specific compositions for material layers (180; column 5, lines 30 – 44) on a Cu (160; column 4, lines 21 – 22). It would have been obvious to one of ordinary skill in the art at the time when the invention was made to add the Co and Ru as the specific composition

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for the material layers on the Cu of Chung as taught by Dubin et al. to improve the adhesion between interconnection material and an overlying, subsequently introduced dielectric layers (column 4, lines 64 – 66).

*Allowable Subject Matter*

8. Claims 20 – 24, 39, 47 and 48 are allowed for the reasons provided in the previous Office action in paragraph nine.
9. Claims 16 – 18 and 24 – 26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
  - (a) Claim 16 contains allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a removing said liner from horizontal surfaces on said dielectric followed by selectively seeding the copper and then plating a capping layer on the seeding by electroless plating.
  - (b) Since claims 17 and 18 are dependent claims of an objected claim (claim 16), these claims are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims (e.g., 16).
  - (c) Claims 25 and 26 contain allowable subject matter because none of references of record teach or suggest, either singularly or in combination, at least the limitation of a metal or alloy being applied through a nozzle for a selective

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electroplating and the nozzle being circular with a diameter smaller than a diameter of a substrate for reducing the overall current during the electroplating and wherein the electroplating is carried out under substantially constant current conditions.

*Response to Arguments*

10. Applicant's arguments filed on January 19, 2005 have been fully considered but they are not persuasive.

On page 9, applicant argues "Chung does not suggest selectively depositing barrier layer 14 on the Cu or fill material. Instead, Chung suggests blanket depositing the barrier layer 14 over the 'first barrier layer 6' and to fill the recess." This argument is not persuasive. Since applicant does not specifically define the length and location of the selectively depositing (e.g., selected area is an entire top surface of a chip, the top and bottom surface of the chip, the entire side surfaces of the chip, a portion of the top surface of the chip, etc.) on the Cu layer, the deposition of the layer 14 shown in Fig. 5 of Chung read as a "selectively depositing".

Furthermore, applicant argues "nothing in Chung suggests selecting electroetching to form the recess ... in combination with electroplating." This argument is not persuasive. According to applicants' specification on page 7, section 0040, the electropolishing is a part of an electroetching and Chung discloses in e.g., column 7, lines 45 – 47 an electropolishing to etch the Cu layer. Thus, Chung discloses electroetching. Also, Chung discloses the electroplating process of the barrier layer 14 on column 7, lines 15 – 22 and lines 49 – 54 after the electroetching the Cu to form the recess (see Figs. 4



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and 5 of Chung). In contrary to applicant's assertion and as stated in the rejection, Chung discloses selecting electroetching to form the recess in combination with electroplating.

For the above reasons, the rejection is maintained.

### *Conclusion*

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is 571-272-1724. The examiner can normally be reached on 11:30 - 8:00.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 517-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Chris C. Chu  
Examiner  
Art Unit 2815

c.c.  
Wednesday, March 30, 2005

  
**GEORGE ECKERT**  
**PRIMARY EXAMINER**